Amendments to the Drawings:

The attached sheets of drawings include changes to Figs. 4, 9, 10, 13 and 20. These sheets replace the original sheets. In Fig. 4, one of reference numerals 60a is corrected to be 60b. In Fig. 9, misspelled "TEMERATURE" is corrected into "TEMPERATURE". In Fig. 10, misspelled "EVAVORTOR", "REFLEETING" and "TEERMOCOUPLE" are rectified into "EVAPORATOR", "REFLECTING" and "THERMOCOUPLE", respectively. In Fig. 13, reference numeral 12 is changed into 14; reference numeral 22 is deleted; and reference numeral 84 is added. In Fig. 20, one of reference numerals 210 is changed to be 280.

Attachment: Replacement Sheets
Annotated Sheets showing Changes

REMARKS/ARGUMENTS

Reconsideration of the application is respectfully requested for the following reasons:

Objection to the drawings

The Office Action objected to Figures 4, 9, 10, 13 and 20. As shown in the attached replacement sheet, appropriate changes are made to Figures 4, 9, 10, 13 and 20. Thus, it is respectfully requested that the objection to the drawings be withdrawn.

Objection to the abstract and the specification

The Office Action objected to the abstract and the specification. Errors have been rectified and appropriate changes are made to the abstract and the specification as the Examiner suggested. Thus, it is respectfully requested that the objection to the abstract and the specification be withdrawn.

Rejection of claims 1 to 15 under 35 U.S.C. 103(a) as being unpatentable over Hall et al. (WO 99/12638)

Claims 1-4, 9-12, 14 and 15 have been amended to clarify the subject matters thereof.

The invention as defined in the amended claim 1 is directed to a purification system of exhaust gases in an internal combustion engine for purifying the exhaust gases by disposing a reaction furnace in an exhaust pipe of the internal combustion engine. The system is comprised of a reactor including a honeycomb carrier having a plurality of carrier cells in the reaction furnace and a plasma generating means. On each of the plurality of carrier cells, a photocatalyst layer is coated. Further, the plasma generating means, having a plurality of electrode cells, is mounted at an inner end and an outer end of the honeycomb carrier. According to the purification system of the present invention, plasma can be obtained, which is sufficient for activating the photocatalyst with a small amount of energy at a pressure higher than the atmospheric pressure. Moreover, the purification system is featured in that the activated photocatalyst acts as a catalyst in both of oxidation reaction and reduction reaction, thereby purifying HC, CO, NO_X, and PM(Particulate Matters) at the same time.

In accordance with the present invention, photocatalysis at the surface of honeycomb monolith substrate helps generated plasma penetrate into the axial direction of narrow and long honeycomb cell paths with much less electrical energy consumption, and this could be explained as follows. It is observed that for a smooth surface honeycomb, there would be no plasma generation even if a high voltage is applied. The plasma generation from the photocatalyst-coated honeycomb surface is in the form of a surface discharge having the following discharge mechanisms in sequence. First, when microscopically examined, it can be seen that the photocatalyst-coated honeycomb surface includes countless

mountains and valleys formed thereon. Mountains of a coated surface are acting as electrodes with the distance of two peaks apart. Second, mountains are then alternately charged positively and negatively, and the small discharge occurs between two oppositely charged mountains. Third, these small discharges between mountains occur continuously along the whole length of coated honeycomb. Fourth, this surface discharge is further strengthened by electrons coming out from activated photocatalyst. This step is very important because the plasma cannot propagate through the whole surface without this strengthening effect due to electrons. Fifth, the activated photocatalyst having a positive hole is regenerated back to its original form by H_2O. Sixth, the regenerated photocatalyst would again trigger reactions in such a way to generate more intensified plasma (G.S. Son, S.W. Yun, J.W. Song, J.A. Kang and K.Y. Lee, "Fundamental Study on Durability of Photocatalyst –Plasma- Honeycomb(PPH) Converter", 2003 Society of Automotive Engineers, Inc.; G. S. Son, S. W. Yun, S. H. Ko, J. W. Song and K. Y. Lee, "Photodegradation of VOCs and Bad Smells in a TiO_2 Coated Honeycomb Monolith Reactor", J. Advanced Oxidation Technology, Accepted for publication (2002)). According to the present invention, two major problems are resolved; the first one is that UV irradiation can now be reached the innermost cells of a honeycomb substrate, thereby the reactor geometry is no longer a factor to limit the UV irradiation and plasma can be stably generated in a reactor much longer than 7mm, up to 75mm. (It is known that, in a conventional reactor, plasma could reach only 4~7mm at a pressure higher than an atmospheric pressure.) Further, The second one is that the decrease in energy yield is not observed due to the recombination of photo-produced holes and electrons.

Hall et al. disclose a reactor chamber, the chamber forming a part of an exhaust system of an internal combustion engine. Within the chamber are electrodes and between which there is disposed a bed of active material through which the exhaust gases pass. Herein, the active material has a catalytic action. However, since Hall et al.'s reactor chamber employs a pellet type reactor bed, it has the same problems with the prior art. Because the exhaust gases of the internal combustion engine are at a pressure higher than the atmospheric pressure, a considerably high voltage needs to be applied in order to generate plasma and a large amount of energy consumption is required to maintain the plasma. Further, in Hall et al., a photocatalyst functions only to catalyse the reduction of nitrogenous oxides to nitrogen in the presence of plasma activated hydrocarbons.

As the Examiner stated, Hall et al. disclose that the gas permeable bed may have a mixed structure and a honeycomb section can be one section of the mixed structure. Although Hall et al. mention that different types of plural reactor chambers can be serially connected, it never teach or suggest the combination of a chamber having a bed of photocatalytic material and a honeycomb chamber. Further, as mentioned above, since Hall's et al.'s reactor chamber has the same problems with the prior art, a person skilled in the art would not be motivated to modify the reference into the present invention.

The invention as defined in the amended claim 3 is directed to the purification system of claim 1 which further includes a 3-way catalyst layer coated on a wall surface of each of the carrier cells. Since the surface of each carrier cells are coated with a 3-way catalyst layer and a photocatalyst material layer, it shows a

high performance in purifying the exhaust gases. Because the photocatalyst reaction is mostly exothermic reaction, heat is supplied to the 3-way catalyst layer coated beneath the photocatalyst layer, allowing the 3-way catalyst to be activated to thereby purify a carbon monoxide, a hydrocarbon, and a nitrogen oxide.

The invention as defined in claims 9-11 relates to arrangements of the electrodes with respect to the honeycomb carrier. According to the arrangements of the electrodes wherein each of the electrodes 50a and 50b is distinctly or closely disposed from/to both ends of the honeycomb carrier 30, the purification system of the present invention can obtain a proper amount of plasma photic for purifying the exhaust gases, while improving an energy efficiency.

Therefore, since the prior art references lack at least the above recited features of the presently claimed invention, and since there is no possible motivation to include the features, it is respectfully submitted that the cited references could have not suggested the claimed invention, and that the rejection under 35 USC 103(a) is therefore improper.

Claims 2-15 are allowable for at least the same reasons as independent claim 1 on which they depend, as well as for their own features which are not taught or suggested by the cited references. Thus, allowance of claims 1-15 is respectfully requested.

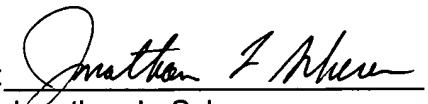
CONCLUSION

Applicant believes that this is a full and complete response to the Office Action. For the reasons discussed above, applicant now respectfully submits that all of the pending claims are in complete condition for allowance. Accordingly, it is respectfully requested that the Examiner's rejections be withdrawn; and that claims 1-15 be allowed in their present form.

Should the Examiner require or consider it advisable that the specification, claims an/or drawings be amended or corrected in formal respects, in order to place the case in condition for final allowance, then it is respectfully requested that such amendment or correction be carried out by Examiner's Amendment and the case be passed to issue.

Alternatively, should the Examiner feel that a personal discussion might be helpful in advancing this case to allowance, the Examiner is invited to telephone the undersigned.

Respectfully submitted,

By: 

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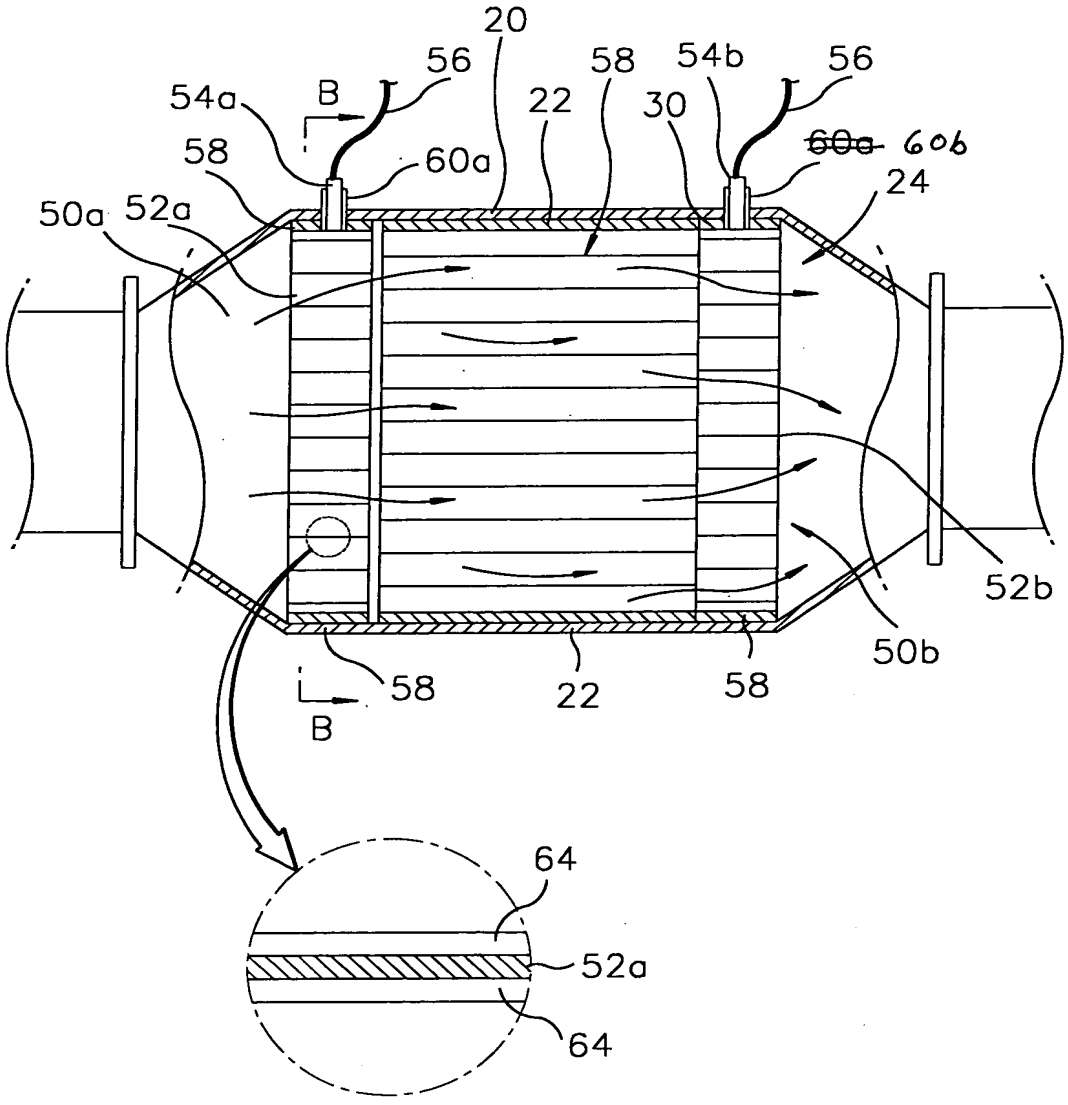
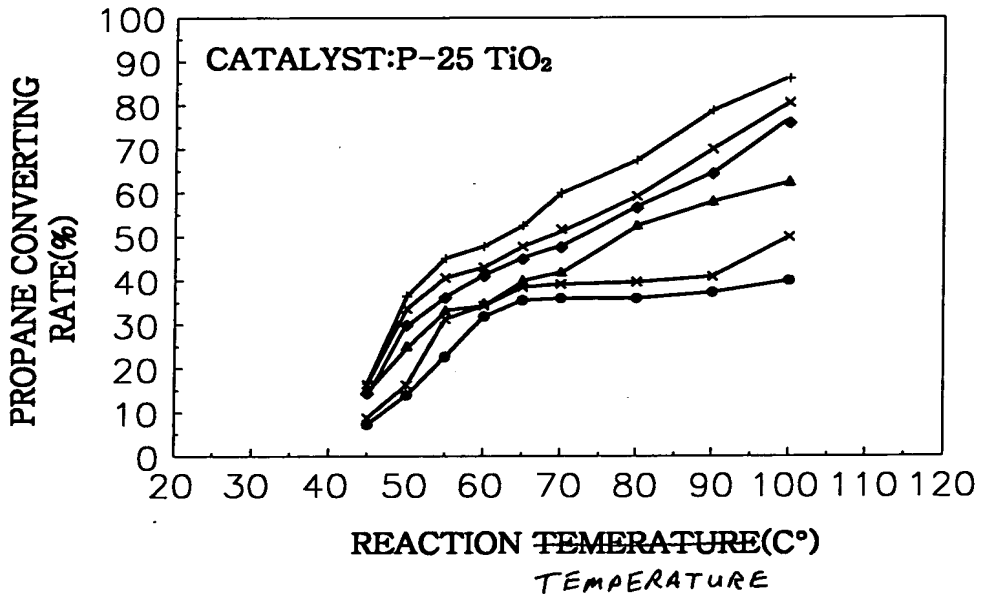
Date: May 6, 2005May 6, 2005

FIG. 4



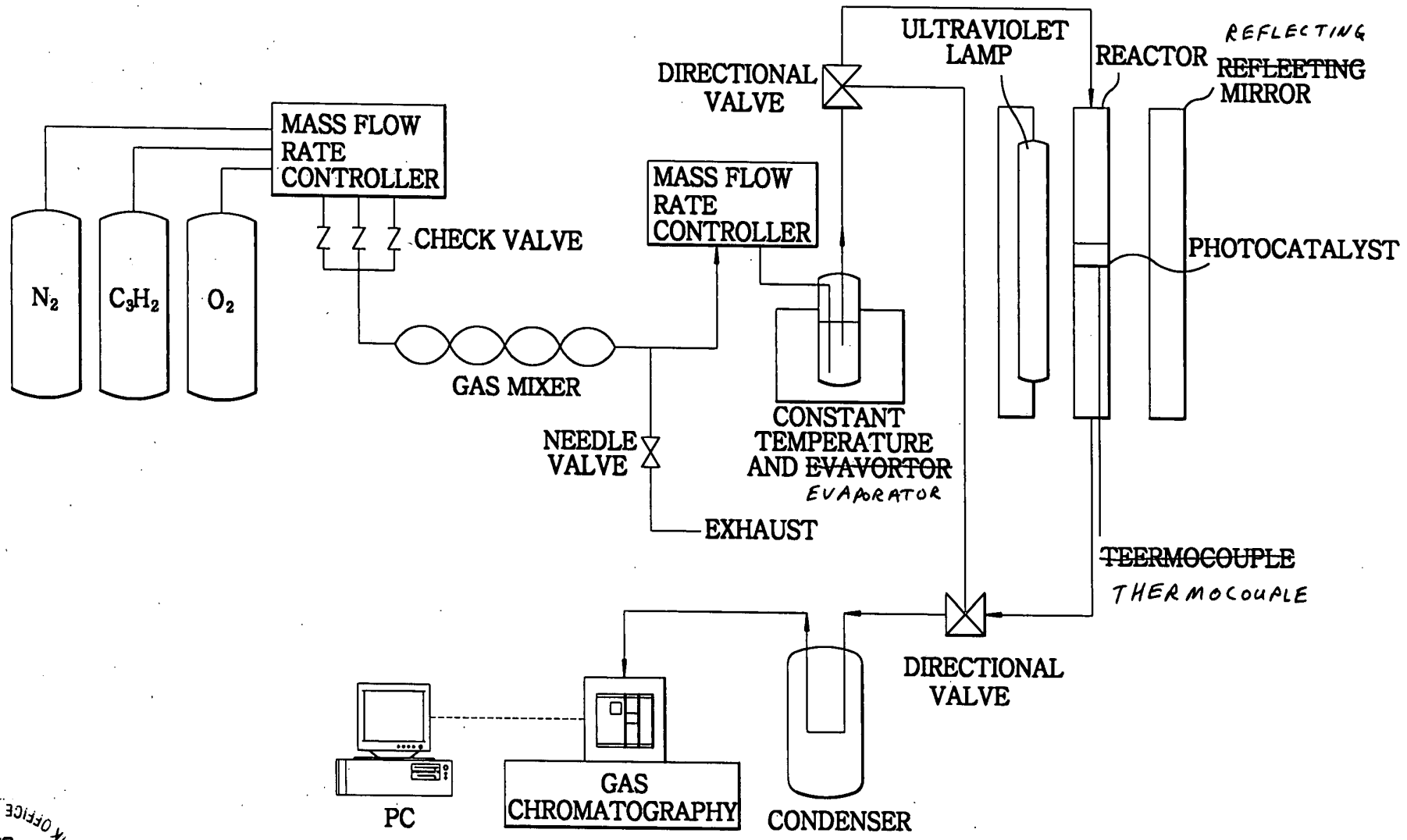
ANNOTATED SHEET SHOWING CHANGES

FIG. 9



ANNOTATED SHEET SHOWING CHANGES

FIG. 10



ANNOTATED SHEET SHOWING CHANGES

FIG. 12

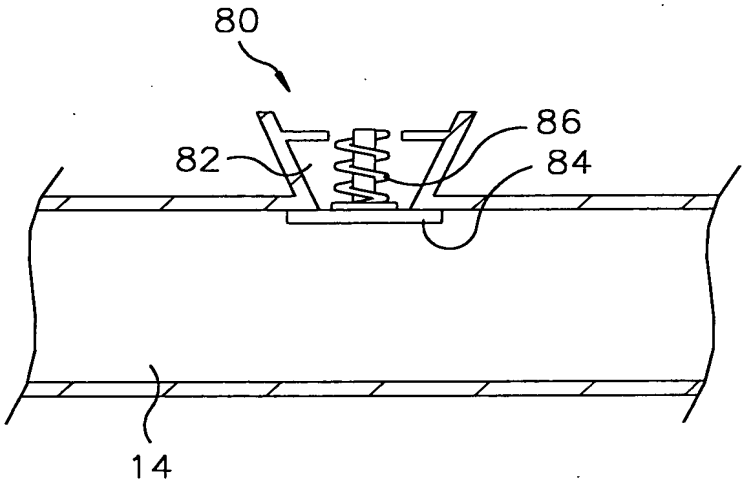
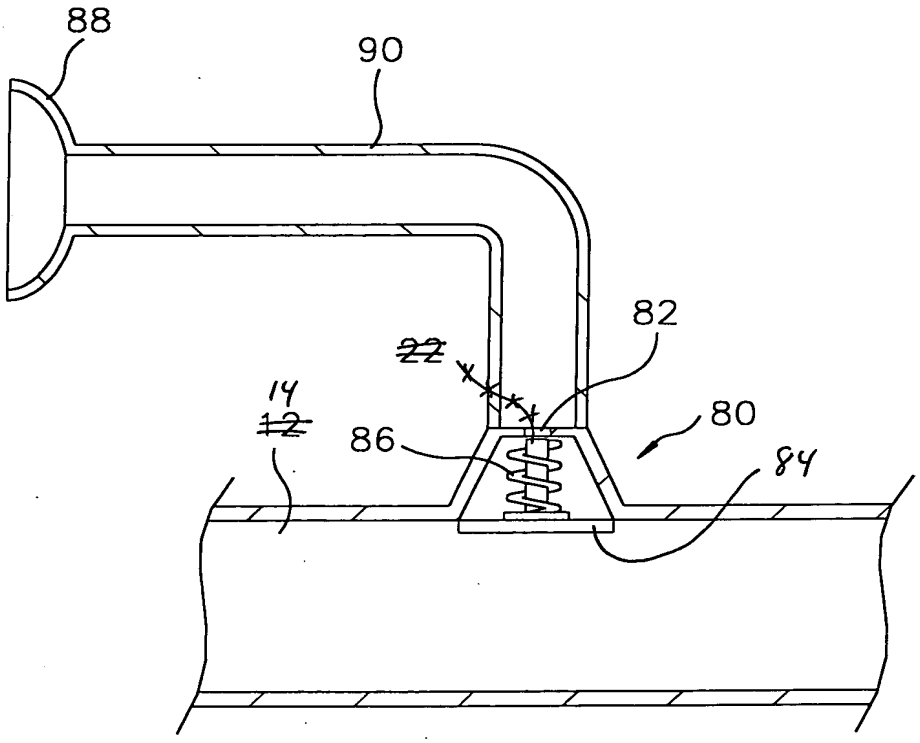
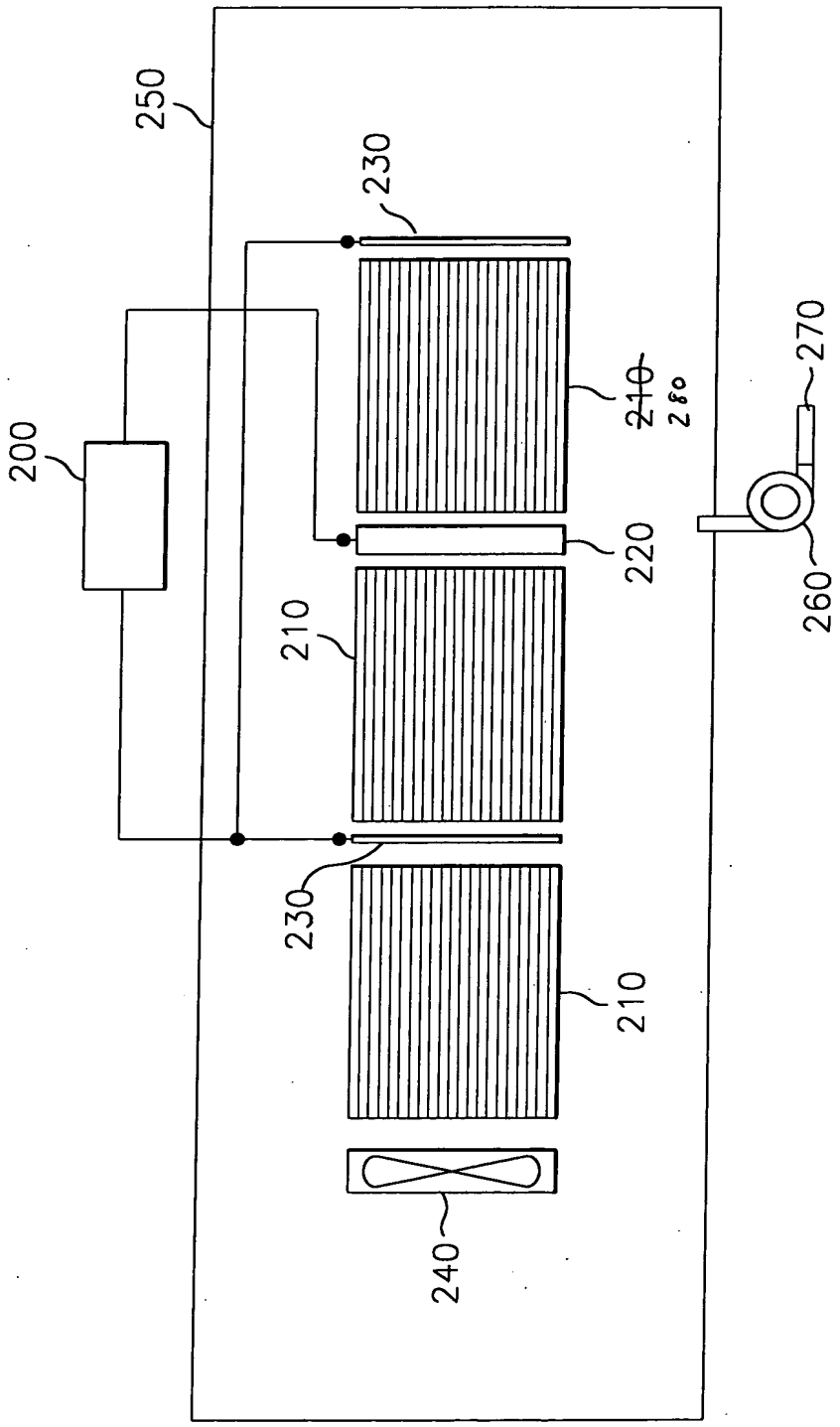


FIG. 13



ANNOTATED SHEET SHOWING CHANGES

FIG.20



ANNOTATED SHEET SHOWING CHANGES